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## (12) United States Patent

Rudmann et al.

(54) OPTOELECTRONIC MODULES THAT HAVE SHIELDING TO REDUCE LIGHT LEAKAGE OR STRAY LIGHT, AND FABRICATION METHODS FOR SUCH MODULES

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(58) Field of Classification Search

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See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

9,094,593 B2 7/2015 Rudmann et al. 2007/0109439 A1 5/2007 Minamio et al.

(Continued)

FOREIGN PATENT DOCUMENTS

SG 11201502994X 5/2015 WO WO 2009/076788 6/2009

OTHER PUBLICATIONS

Astrom, B.T., "Manufacturing of Polymer Composites", *Manufacturing Techniques* (1997), pp. 219-263.

(Continued)

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(57) ABSTRACT

Various optoelectronic modules are described that include an optoelectronic device (e.g., a light emitting or light detecting element) and a transparent cover. Non-transparent material is provided on the sidewalls of the transparent cover, which, in some implementations, can help reduce light leakage from the sides of the transparent cover or can help prevent stray light from entering the module. Fabrication techniques for making the modules also are described.

29 Claims, 43 Drawing Sheets

